IN THE SPECIFICATION:

Please amend the specification as follows:

Please delete the paragraphs beginning at page 9, line 26 through page 24, line 12 as follows.

~~[0024]~~

~~Furthermore, step reduction and improved productivity can be realized, when a plurality of seals are assembled onto a fuel injection valve.~~

~~BEST MODE FOR CARRYING OUT THE INVENTION~~

~~[0025]~~

~~Hereinafter, preferable embodiments according to the present invention will be illustratively explained in detail, referring to drawings. However, with regards to sizes, materials, shapes, and relative arrangements, and the like for components described in the embodiments, the scope of the present invention are not limited to the above embodiments, unless otherwise specified.~~

~~[0026]~~

~~(First Embodiment)~~

FIG. 1 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a first embodiment of the present invention is assembled onto a fuel injection valve.

[0027]

The combustion-gas seal 1 for a fuel injection valve (hereinafter, simply called "combustion-gas seal") prevents leakage of combustion gas from the side near a cylinder (right-hand side in the drawing) by sealing an annular clearance gap between a mounting hole 40 provided in a cylinder head (housing) 4 of a direct injection engine and a fuel injection valve 5 mounted in the mounting hole 40.

[0028]

The combustion-gas seal 1 in the present embodiment includes a seal ring 10 as a main seal, and a seal washer 11 as a secondary seal.

[0029]

The seal ring 10 is a seal ring with a rectangular cross section, and the ring is installed into an annular groove 51 provided on the outer peripheral surface at the tip portion of the fuel injection valve 5. A rubber-like elastic material or a resin material may be used as the material of the seal ring 10, but, considering the temperature and the components and the like of the combustion gas, it is

preferable to use a heat-resistant material with a high resistance to chemicals. For example, PTFE (polytetrafluoroethylene) may be preferably used.

[0030]

The inside diameter of the seal ring 10 is set to be a little smaller than the diameter of the bottom surface of the annular groove 51, and the outside diameter is also set to be slightly larger than the diameter of the peripheral surface of the mounting hole 40, wherein the surface is opposing to the annular groove 51. because the seal ring 10 has such a squeeze, When the fuel injection valve 5 is mounted into the mounting hole 40, compressive deformation is caused in the seal ring 10, and the seal ring comes hermetically contact with the bottom surface of the annular groove 51 and the peripheral surface of the mounting hole 40 due to an elastically recovering force,. Thereby, the leakage of the combustion gas from the cylinder side is prevented.

[0031]

Moreover, in the present embodiment, the annular groove 51 is provided with a tapered portion 52 on the bottom surface thereof, and the tapered portion is configured such that closer to the rear end of the fuel injection valve (left-hand side in the drawing), the depth of the groove become shallower. Thereby, when the pressure of the combustion gas is applied to the seal ring 10,

and the ring 10 is moved backward in the groove, the degree of adhesion by the seal ring 10 is improved to cause better sealing ability.

[0032]

A seal washer 11 includes a metal ring 11a, and a rubber-like elastic portion 11b which is fitted to the outer peripheral surface of the metal ring 11a by baking. Considering the environments around an engine room, a material with a heat resistance up to about 120°C through 150°C is preferable as a material for the rubber-like elastic portion 11b on a higher temperature side. Moreover, a material which can exhibit the rubber-like elasticity even at about -40°C is preferable for a lower temperature side.

[0033]

The seal washer 11 is sandwiched and fixed between the cylinder head 4 and the fuel injection valve 5 at a position toward the rear end of the fuel injection valve from the seal ring 10. That is, when the fuel injection valve 5 is fastened into the cylinder head 4, the seal washer 11 is configured to be fixed by holding the metal ring 11a between the step surface 53 of the fuel injection valve 5 and the step surface 41 of the mounting hole 40, those surfaces are extended in a direction approximately perpendicularly to the mounting direction (direction indicated by an arrowhead in the drawing) of the fuel injection valve.

[0034]

In the present embodiment, the sectional shape of the metal ring 11a is configured to be a U-shape opening inwardly on the inner peripheral surface. Thereby, when the metal ring 11a is sandwiched between two step surfaces 53 and 41, the ring 11a is compressed and deformed in the mounting direction of the fuel injection valve, and applies strong pressing force to the step surfaces 53 and 41 by the elastically recovering force. That is, the metal ring 11a functions as a metal leaf spring to improve the stability for installing the seal washer 11.

[0035]

When the washer 11 is fixed as described above, the rubber-like elastic portion 11b is adhered to the step surfaces 53 and 41. Since the rubber-like elastic portion 11b is very elastic, the rubber-like elastic portion 11b has an excellent followability to the step surfaces 53 and 41 as a seal surface and high degree of adhesion thereto, that is, preferable sealing ability is realized.

[0036]

At this time, it is further preferable to add a lip to the rubber-like elastic portion 11b. That is, the lip has a configuration in which the width of at least a part of the rubber-like elastic portion 11b in the mounting direction of the fuel injection valve is wider than that of the metal ring 11a to secure a squeeze for

the step surfaces 53 and 41. Thereby, when the rubber-like elastic portion 11b is sandwiched between the step surfaces 53 and 41, the rubber-like elastic portion 11b is compressed in the mounting direction of the fuel injection valve, and adhesion force to the step surfaces 53 and 41 is increased by the elastically recovering force (so-called self-sealing function). Accordingly, the sealing ability may be further improved.

[0037]

According to the configuration in this embodiment described above, the seal washer 11 can function as a secondary seal, and combustion gas which leaks from the seal ring 10 can be surely sealed by the seal washer 11. Accordingly, a sealing ability of the whole combustion-gas seal is improved, and an excellent sealing ability is realized for a long term.

[0038]

Moreover, the position at which the seal ring 10 is installed may be set, by providing the seal washer 11 as a secondary seal, at a position toward the tip of the fuel injection valve 5 (toward the right-hand side in the drawing), because the allowable damaged and leakage ranges of the seal ring 10 itself may be extended. Then, an advantage that temperature rise at the tip portion of the fuel injection valve is controlled may be expected.

[0039]

Furthermore, as the fuel injection valve 5 is fastened into the cylinder head 4, the seal washer 11 is simultaneously sandwiched (assembled). Accordingly, only the seal ring 10 is assembled as a seal onto the fuel injection valve 5 itself without increasing steps for assembling the seal onto the fuel injection valve 5 itself. That is, addition of the seal washer 11 does not cause reduction in the productivity.

[0040]

(Second Embodiment)

FIG. 2 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a second embodiment of the present invention is assembled onto a fuel injection valve. In FIG. 2, portions similar to those in the above-described first embodiment (FIG. 1) are denoted by the same reference numerals as those in FIG. 1. Hereinafter, main explanation will be made for portions peculiar to the present embodiment.

[0041]

A combustion-gas seal 2 according to the present embodiment includes a seal ring 10 as a main seal, and a heat-resistant ring 12 as a thermoprotector.

[0042]

The heat-resistant ring 12 is a ring-like member with a rectangular cross section, wherein the member is installed into a second annular groove 54 provided at a position toward the tip side of a fuel injection valve from an annular groove 51 in which the seal ring 10 is installed. The heat-resistant ring 12 reduces the entering quantity of combustion gas into an annular clearance gap in the vicinity of the tip end of the fuel injection valve 5.

[0043]

The heat-resistant ring 12 is preferably arranged in the vicinity of the tip end of the fuel injection valve 5 in order to enhance the reducing effect of the entering quantity of the fuel gas. On the other hand, the seal ring 10 is preferably configured to be held away to a certain degree from the tip end of the fuel injection valve 5 for control of damage by fuel gas.

[0044]

According to the configuration in the present embodiment, damage of the seal ring 10 can be controlled and an excellent sealing ability can be realized for a long term, because the heat-resistant ring 12 reduces the entering quantity of combustion gas to reduce load put on the seal ring 10.

[0045]

Moreover, since temperature rise at the tip portion of the fuel injection valve is controlled by providing the heat-resistant ring 12, adhesion of deposit can be prevented, and stable movement of the fuel injection valve 5 can be maintained.

[0046]

Considering the temperature, the components, and the like of the combustion gas, it is preferable to use a high heat-resistant material with a high resistance to heat and chemicals as the material of the heat-resistant ring 12. For example, a resin material such as PTFE (polytetrafluoroethylene) may be preferably used.

[0047]

Since the heat-resistant ring 12 is required only to have sealing ability necessary and sufficient for reduction in the entering quantity of combustion gas, a squeeze may be provided, or may not be provided. When the squeeze is provided, the reducing effect of the entering quantity of combustion gas is enhanced, because the sealing ability of the heat-resistant ring 12 is improved. On the other hand, when the squeeze is not provided, there is an advantage that the fuel injection valve 5 can be more easily assembled into a mounting hole 40. Moreover, it is preferable to improve the sealing ability of the heat-resistant ring

12 by providing, on the bottom surface of the second annular groove 54, a similar taper portion to that of the annular groove 51.

[0048]

In the present embodiment, the outside diameter of the heat-resistant ring 12 is configured to be approximately the same as that of the seal ring 10 (regardless of the presence of the squeeze). The above configuration enables commonality of an installing jig and a correcting jig, and reduction in the number of assembling steps is realized.

[0049]

Then, a method for assembling the seal ring 10 and the heat-resistant ring 12 onto the fuel injection valve will be specifically explained, referring to FIG. 3A through FIG. 3D.

[0050]

As shown in FIG. 3A and FIG. 3B, an installing jig 6 installs a ring into a groove of the fuel injection valve 5, while the inside diameter of the ring is being extended. The diameter of the installing jig 6 at the lead-in side (upper side in the drawing) of the ring is configured to be enough smaller than the inside diameter of the ring. Then, the diameter of the installing jig 6 gradually becomes larger from the middle thereof toward the side (lower side in the drawing), on

~~which the ring is installed, in a conical manner. A cylinder portion is provided at the lower end of the installing jig 6, and the ring can be led into the groove by covering the tip portion of the fuel injection valve with the cylinder portion.~~

~~[0051]~~

~~On the other hand, a correcting jig 7 corrects the diameter which has been extended when the ring is installed. The correcting jig 7 has a correcting hole 70 in accordance with the (original) outside diameter of the ring. The correcting jig 7 is supported by a base 71 in such a way that the jig 7 can be slidden in the axis direction (vertical direction in the drawing) of the fuel injection valve 5 and a correcting jig Assy 72 includes the correcting jig 7 and the base 71.~~

~~[0052]~~

~~As shown in FIG. 3A, the fuel injection valve 5 is inserted into the correction hole 7O of the correcting jig 7 in the first place for positioning. At this time, the correcting jig 7 is arranged in the annular groove 51 at the side (lower side in the drawing) of the rear end of the fuel injection valve.~~

~~[0053]~~

~~Then, the installing jig 6 is put onto the tip portion of the fuel injection valve 5 for positioning. At this time, the installing jig 6 covers the~~

second annular groove 54, and is arranged at a position at which the seal ring 10 can be led into the annular groove 51.

[0054]

And, while the inside diameter of the seal ring 10 is gradually extended by leading the seal ring 10 onto the installing jig 6 and by sliding the ring along the peripheral surface of the installing jig 6 from the lead-in side, the seal ring 10 is installed into the annular groove 51. Since the ring of the resin material has low elasticity, it is not easy to return the diameter to the initial one only by the elastically recovering force of its own.

[0055]

Then, after installing the seal ring 10, the correcting jig 7 is relatively slidden to an installing position of the seal ring 10 as shown in FIG. 3B, and correction of the seal ring 10 is executed.

[0056]

As the correction is executed, the installing jig 6 is relatively slidden in a simultaneous manner to a position at which the heat-resistant ring 12 can be led into the second annular groove 54, and the heat-resistant ring 12 is installed into the second annular groove 54 during the correction of the seal ring 10.

[0057]

After installing the heat-resistant ring 12, the installing jig 6 is removed, as shown in FIG. 3C, and the fuel injection valve 5 and the correcting jig 7 are slidden downward for positioning of the fuel injection valve 5 at the position.

[0058]

Then, the heat-resistant ring 12 is corrected by relatively sliding the correcting jig 7 to a position for installing the heat-resistant ring 12, as shown in FIG. 3D, after completing the correction of the seal ring 10.

[0059]

According to the above-described assembling method, the seal ring 10 and the heat-resistant ring 12 can be sequentially installed and corrected, and the heat-resistant ring 12 can be installed during correction of the seal ring 10, using one set of the installing jig and the correcting jig. Accordingly, step reduction and improved productivity can be realized.

[0060]

(Third Embodiment)

FIG. 4 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a third embodiment of the present invention is assembled onto a fuel injection valve. In FIG. 4, portions similar to those in the

above-described first and second embodiments (FIG. 1 and FIG. 2) are denoted by the same reference numerals as those in FIG. 1 and FIG. 2.

[0061]

A combustion-gas seal 3 according to the present embodiment includes a seal ring 10 as a main seal, a seal washer 11 as a secondary seal, and a heat-resistant ring 12 as a thermoprotector. Each of configurations for the above components has a similar one to that of the above-described embodiments.

[0062]

According to the configuration of the present embodiment, a highly-reliable combustion-gas seal with advantages including both those of the combustion-gas seal according to the first embodiment and those according to the second embodiment may be provided.

BRIEF DESCRIPTION OF THE DRAWING

[0063]

FIG. 1 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a first embodiment of the present invention is assembled onto a fuel injection valve;

FIG. 2 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a second embodiment of the present invention is assembled onto a fuel injection valve;

FIG. 3A is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve;

FIG. 3B is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve;

FIG. 3C is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve;

FIG. 3D is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve; and

FIG. 4 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a third embodiment of the present invention is assembled onto a fuel injection valve.

DESCRIPTION OF REFERENCE NUMERALS

[0064]

1, 2, 3	Combustion-gas seal for fuel injection valve
4	Cylinder head

~~5~~	~~Fuel injection valve~~
~~6~~	~~Installing jig~~
~~7~~	~~Correcting jig~~
~~10~~	~~Seal ring~~
~~11~~	~~Seal washer~~
~~11a~~	~~Metal ring~~
~~11b~~	~~Rubber-like elastic portion~~
~~12~~	~~Heat-resistant ring~~
~~40~~	~~Mounting hole~~
~~41~~	~~Step surface~~
~~51~~	~~Annular groove~~
~~52~~	~~Taper portion~~
~~53~~	~~Step surface~~
~~54~~	~~Second annular groove~~
~~70~~	~~Correcting hole~~
~~71~~	~~Base~~
~~72~~	~~Correcting jig Assy~~

Please insert the following new paragraphs at page 9, line 26 as follows.

Furthermore, step reduction and improved productivity can be realized, when a plurality of seals are assembled onto a fuel injection valve.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a first embodiment of the present invention is assembled onto a fuel injection valve;

FIG. 2A is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve;

FIG. 2B is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve;

FIG. 2C is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve;

FIG. 2D is a view explaining a method by which a seal ring and a heat-resistant ring are assembled onto a fuel injection valve; and

FIG. 3 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a second embodiment of the present invention is assembled onto a fuel injection valve.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, preferable embodiments according to the present invention will be illustratively explained in detail, referring to drawings. However, with regards to sizes, materials, shapes, and relative arrangements, and the like for components described in the embodiments, the scope of the present invention are not limited to the above embodiments, unless otherwise specified.

(First Embodiment)

FIG. 1 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a first embodiment of the present invention is assembled onto a fuel injection valve.

The combustion-gas seal 2 for a fuel injection valve (hereinafter, simply called "combustion-gas seal") prevents leakage of combustion gas from the side near a cylinder (right-hand side in the drawing) by sealing an annular clearance gap between a mounting hole 40 provided in a cylinder head (housing) 4

of a direct injection engine and a fuel injection valve 5 mounted in the mounting hole 40.

The combustion-gas seal 2 according to the present embodiment includes a seal ring 10 as a main seal, and a heat-resistant ring 12 as a thermoprotector.

The seal ring 10 is a seal ring with a rectangular cross section, and the ring is installed into an annular groove 51 provided on the outer peripheral surface at the tip portion of the fuel injection valve 5. A rubber-like elastic material or a resin material may be used as the material of the seal ring 10, but, considering the temperature and the components and the like of the combustion gas, it is preferable to use a heat-resistant material with a high resistance to chemicals. For example, PTFE (polytetrafluoroethylene) may be preferably used.

The inside diameter of the seal ring 10 is set to be a little smaller than the diameter of the bottom surface of the annular groove 51, and the outside diameter is also set to be slightly larger than the diameter of the peripheral surface of the mounting hole 40, wherein the surface is opposing to the annular groove 51. Because the seal ring 10 has such a squeeze, when the fuel injection valve 5 is mounted into the mounting hole 40, compressive deformation is caused in the seal ring 10, and the seal ring comes hermetically contact with the bottom surface of

the annular groove 51 and the peripheral surface of the mounting hole 40 due to an elastically recovering force. Thereby, the leakage of the combustion gas from the cylinder side is prevented.

Moreover, in the present embodiment, the annular groove 51 is provided with a tapered portion 52 on the bottom surface thereof, and the tapered portion is configured such that closer to the rear end of the fuel injection valve (left-hand side in the drawing), the depth of the groove become shallower. Thereby, when the pressure of the combustion gas is applied to the seal ring 10, and the ring 10 is moved backward in the groove, the degree of adhesion by the seal ring 10 is improved to cause better sealing ability.

The heat-resistant ring 12 is a ring-like member with a rectangular cross section, wherein the member is installed into a second annular groove 54 provided at a position toward the tip side of a fuel injection valve from an annular groove 51 in which the seal ring 10 is installed. The heat-resistant ring 12 reduces the entering quantity of combustion gas into an annular clearance gap in the vicinity of the tip end of the fuel injection valve 5.

The heat-resistant ring 12 is preferably arranged in the vicinity of the tip end of the fuel injection valve 5 in order to enhance the reducing effect of the entering quantity of the fuel gas. On the other hand, the seal ring 10 is preferably

configured to be held away to a certain degree from the tip end of the fuel injection valve 5 for control of damage by fuel gas.

According to the configuration in the present embodiment, damage of the seal ring 10 can be controlled and an excellent sealing ability can be realized for a long term, because the heat-resistant ring 12 reduces the entering quantity of combustion gas to reduce load put on the seal ring 10.

Moreover, since temperature rise at the tip portion of the fuel injection valve is controlled by providing the heat-resistant ring 12, adhesion of deposit can be prevented, and stable movement of the fuel injection valve 5 can be maintained.

Considering the temperature, the components, and the like of the combustion gas, it is preferable to use a high heat-resistant material with a high resistance to heat and chemicals as the material of the heat-resistant ring 12. For example, a resin material such as PTFE (polytetrafluoroethylene) may be preferably used.

Since the heat-resistant ring 12 is required only to have sealing ability necessary and sufficient for reduction in the entering quantity of combustion gas, a squeeze may be provided, or may not be provided. When the squeeze is provided, the reducing effect of the entering quantity of combustion gas is enhanced,

because the sealing ability of the heat-resistant ring 12 is improved. On the other hand, when the squeeze is not provided, there is an advantage that the fuel injection valve 5 can be more easily assembled into a mounting hole 40. Moreover, it is preferable to improve the sealing ability of the heat-resistant ring 12 by providing a tapered portion similar to that of the annular groove 51 on the bottom surface of the second annular groove 54.

In the present embodiment, the outside diameter of the heat-resistant ring 12 is configured to be approximately the same as that of the seal ring 10 (regardless of the presence of the squeeze). The above configuration enables shareability of an installing jig and a correcting jig, and reduction in the number of assembling steps is realized.

Then, a method for assembling the seal ring 10 and the heat-resistant ring 12 onto the fuel injection valve will be specifically explained, referring to FIG. 2A through FIG. 2D.

As shown in FIG. 2A and FIG. 2B, an installing jig 6 installs a ring into a groove of the fuel injection valve 5, while the inside diameter of the ring is being extended. The diameter of the installing jig 6 at the lead-in side (upper side in the drawing) for the ring is configured to be enough smaller than the inside diameter of the ring. Then, the diameter of the installing jig 6 gradually becomes

larger from the middle thereof toward the side (lower side in the drawing), near the position on which the ring is installed, in a conical manner. A cylinder portion is provided at the lower end of the installing jig 6, and the ring can be led into the groove by covering the tip portion of the fuel injection valve with the cylinder portion.

On the other hand, a correcting jig 7 corrects the diameter which has been extended when the ring is installed. The correcting jig 7 has a correcting hole 70 in accordance with the (original) outside diameter of the ring. The correcting jig 7 is supported by a base 71 in such a way that the jig 7 can be slidden in the axis direction (vertical direction in the drawing) of the fuel injection valve 5 and a correcting jig assembly 72 includes the correcting jig 7 and the base 71.

As shown in FIG. 2A, the fuel injection valve 5 is inserted into the correction hole 7O of the correcting jig 7 in the first place for positioning. At this time, the correcting jig 7 is arranged in the annular groove 51 at the side (lower side in the drawing) near the rear end of the fuel injection valve.

Then, the installing jig 6 is put onto the tip portion of the fuel injection valve 5 for positioning. At this time, the installing jig 6 covers the

And, while the inside diameter of the seal ring 10 is gradually extended by leading the seal ring 10 onto the installing jig 6 and by sliding the ring along the peripheral surface of the installing jig 6 from the lead-in side, the seal ring 10 is installed into the annular groove 51. Since the ring of the resin material has low elasticity, it is not easy to return the diameter to the initial one only by the elastically recovering force of its own.

Then, after installing the seal ring 10, the correcting jig 7 is relatively slidden to an installing position of the seal ring 10 as shown in FIG. 2B, and correction of the seal ring 10 is executed.

As the correction is executed, the installing jig 6 is relatively slidden in a simultaneous manner to a position at which the heat-resistant ring 12 can be led into the second annular groove 54, and the heat-resistant ring 12 is installed into the second annular groove 54 during the correction of the seal ring 10.

After installing the heat-resistant ring 12, the installing jig 6 is removed, as shown in FIG. 2C, and the fuel injection valve 5 and the correcting jig 7 are slidden downward for positioning of the fuel injection valve 5 at the position.

Then, the heat-resistant ring 12 is corrected by relatively sliding the correcting jig 7 to a position for installing the heat-resistant ring 12, as shown in FIG. 2D, after completing the correction of the seal ring 10.

According to the above-described assembling method, the seal ring 10 and the heat-resistant ring 12 can be sequentially installed and corrected, and the heat-resistant ring 12 can be installed during correction of the seal ring 10, using one set of the installing jig and the correcting jig. Accordingly, step reduction and improved productivity can be realized.

(Second Embodiment)

FIG. 3 is a view showing a state in which a combustion-gas seal for a fuel injection valve according to a second embodiment of the present invention is assembled onto a fuel injection valve. In FIG. 3, portions similar to those in the above-described first embodiment (FIG. 1) are denoted by the same reference numerals as those in FIG. 1 and FIG. 2.

A combustion-gas seal 3 according to the present embodiment includes a seal ring 10 as a main seal, a seal washer 11 as a secondary seal, and a heat-resistant ring 12 as a thermoprotector. Configurations of the seal ring 10 and the heat-resistant ring 12 in the present embodiment are similar to those in the above-described embodiments.

A seal washer 11 includes a metal ring 11a, and a rubber-like elastic portion 11b which is fitted to the outer peripheral surface of the metal ring 11a by baking. Considering the environments around an engine room, a material with a heat resistance up to about 120°C through 150°C is preferable as a material for the rubber-like elastic portion 11b on a higher temperature side. Moreover, a material which can exhibit the rubber-like elasticity even at about -40°C is preferable for a lower temperature side.

The seal washer 11 is sandwiched and fixed between the cylinder head 4 and the fuel injection valve 5 at a position toward the rear end of the fuel injection valve from the seal ring 10. That is, when the fuel injection valve 5 is fastened into the cylinder head 4, the seal washer 11 is configured to be fixed by holding the metal ring 11a between the step surface 53 of the fuel injection valve 5 and the step surface 41 of the mounting hole 40, those surfaces are extended in a direction approximately perpendicularly to the mounting direction (direction indicated by an arrowhead in the drawing) of the fuel injection valve.

In the present embodiment, the sectional shape of the metal ring 11a is configured to be a U-shape opening inwardly on the inner peripheral surface. Thereby, when the metal ring 11a is sandwiched between two step surfaces 53 and 41, the ring 11a is compressed and deformed in the mounting direction of the fuel injection valve, and applies strong pressing force to the step surfaces 53 and 41 by

the elastically recovering force. That is, the metal ring 11a functions as a metal leaf spring to improve the stability for installing the seal washer 11.

When the washer 11 is fixed as described above, the rubber-like elastic portion 11b is adhered to the step surfaces 53 and 41. Since the rubber-like elastic portion 11b is very elastic, the rubber-like elastic portion 11b has an excellent followability to the step surfaces 53 and 41 as a seal surface and high degree of adhesion thereto, that is, preferable sealing ability is realized.

At this time, it is further preferable to add a lip to the rubber-like elastic portion 11b. That is, the lip has a configuration in which the width of at least a part of the rubber-like elastic portion 11b in the mounting direction of the fuel injection valve is wider than that of the metal ring 11a to secure a squeeze for the step surfaces 53 and 41. Thereby, when the rubber-like elastic portion 11b is sandwiched between the step surfaces 53 and 41, the rubber-like elastic portion 11b is compressed in the mounting direction of the fuel injection valve, and adhesion force to the step surfaces 53 and 41 is increased by the elastically recovering force (so-called self-sealing function). Accordingly, the sealing ability may be further improved.

According to the configuration in this embodiment described above, the seal washer 11 can function as a secondary seal, and combustion gas which leaks from the seal ring 10 can be surely sealed by the seal washer 11. Accordingly, a sealing ability of the whole combustion-gas seal is improved, and an excellent sealing ability is realized for a long term.

Moreover, the position at which the seal ring 10 is installed may be set, by providing the seal washer 11 as a secondary seal, at a position toward the tip of the fuel injection valve 5 (toward the right-hand side in the drawing), because the allowable damaged and leakage ranges of the seal ring 10 itself may be extended. Then, an advantage that temperature rise at the tip portion of the fuel injection valve is controlled may be expected.

Furthermore, as the fuel injection valve 5 is fastened into the cylinder head 4, the seal washer 11 is simultaneously sandwiched (assembled). Accordingly, only the seal ring 10 is assembled as a seal onto the fuel injection valve 5 itself without increasing steps for assembling the seal onto the fuel injection valve 5 itself. That is, addition of the seal washer 11 does not cause reduction in the productivity.

According to the configuration of the present embodiment, a highly-reliable combustion-gas seal with advantages including both those of the combustion-gas seal according to the first embodiment and those of the above-described seal washer may be provided.

DESCRIPTION OF REFERENCE NUMERALS

2, 3	Combustion-gas seal for fuel injection valve
4	Cylinder head
5	Fuel injection valve
6	Installing jig

7	Correcting jig
10	Seal ring
11	Seal washer
11a	Metal ring
11b	Rubber-like elastic portion
12	Heat-resistant ring
40	Mounting hole
41	Step surface
51	Annular groove
52	Tapered portion
53	Step surface
54	Second annular groove
70	Correcting hole
71	Base
72	Correcting jig assembly